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leads to the inference that the velocities of the nearer stars are greater than for the distant stars. Such a condition is confirmed by the velocities of 41 stars whose parallaxes have been observed to be 0.″06 or over. Their average radial velocity is 26.9 km. (or 20.7 km. if we omit four stars with velocities of from 73 km. to 98 km.) whereas the average velocity of a large number of stars of similar magnitude and spectral class (including many stars of small μ) which are undoubtedly at a much greater average distance than the 41 stars, may be taken at 15 km. (or 10 km. if limited to small proper motion).

Conclusions.—1. The preference for motion in the direction of the ellipsoidal axis appears to be confined to the stars of larger proper motion and brighter than 3.0 magnitude in all of the spectral classes with the possible exception of K and M. The limit of proper motion below which little or no preference for the ellipsoidal axis is shown, appears to be about 0.″05.

2. The increase in prolateness in the stars of large proper motion can be traced chiefly to the direction of the ellipsoidal axis.

3. This relation to proper motion furnishes a satisfactory explanation of the peculiar behavior of the stars of class B.

4. The radial velocities of the nearer stars are larger than those of the more distant stars.

5. When classified according to size of proper motion, and a few large motions are excluded, there is no certain increase in the radial velocities of the different spectral classes.

6. When the radial velocities are classified according to size of proper motion, there is no certain change with magnitude.

The details of this investigation will be published in the *Astrophysical Journal.*

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[1] *Berkeley, Lick Obs., Univ. Cal. Bull.*, **6**, 1911, (108); **7**, 1913, (20, 113).

[2] *Pasadena, Contrib. Mt. Wilson, Solar Obs.*, No. 105.

[3] These PROCEEDINGS, **1**, 1915, (14).

GROWTH OF ISOLATED SPOROPHYTES OF ANTHOCEROS

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In view of the speculations concerning the possible derivation of the ferns from Anthoceros-like forms, it seemed worth while to determine how far the sporophyte is capable of an independent existence when separated from the supporting gametophyte.

The highly developed photosynthetic tissues of the sporophyte of Anthoceros, and its long period of growth, due to the persistence of actively dividing cells at its base, suggest that if the sporophyte were able to absorb water directly, instead of through the mediation of the gametophyte, it might be possible for it to live and develop when separated from the gametophyte, and thus to simulate the behavior of the young fern-sporophyte.

Preliminary experiments were made in the spring of 1916, and more extended ones were made during the winter and spring of 1916–17.

While these experiments were of a somewhat tentative character, and by no means exhaustive, the results were sufficiently interesting to seem worthy of record.

The species chosen for experiment, *Anthoceros Pearsoni* Howe, is a common liverwort in the vicinity of Stanford University. Young sporophytes were noted during the autumn, and plants were brought in at intervals during the late autumn and winter. They were kept in a cool greenhouse where they grew luxuriantly and furnished abundant material for experiment.

The large foot of the sporophyte is so completely grown to the surrounding tissue of the gametophyte, that it is impossible to completely isolate the sporophyte without removing the foot. It was therefore necessary to cut away, as completely as possible, the gametophytic tissues, thus exposing the foot of the sporophyte.

In the first experiments, the isolated sporophytes were placed with the lower part in a nutritive solution (Knop's Solution) but this was not found to be satisfactory, as bacteria developed to such an extent as to quite envelop the submerged part of the sporophyte, whose growth was thus much interfered with, although in some cases they survived for a month or more.

Much more satisfactory results were obtained by planting in sterilized earth. Small flower-pots filled with earth were thoroughly sterilized, and after planting, the flower-pots were placed in vessels filled with boiled tap water, thus avoiding watering from above. Each pot was covered with a tumbler, and in this way the isolated sporophytes were kept in a healthy state for a surprisingly long time.

Sooner or later Oscillatoria and other algal growths appeared, but probably with proper care these might be pretty well eliminated.

For a short time, a slight increase in length was noted, but this was in no case very marked. The most striking effect of the transplanting was apparently a marked hastening of the spore formation. Most of the specimens selected had not yet begun to show spores, and the young sporophyte throughout was a vivid green. After about a month, most of them showed the darkening of the apical region, indicating the presence of ripe spores, and this darkening soon extended downward until it embraced pretty nearly the whole sporophyte. An examination showed both spores and elaters to be apparently in no way different from those found in normal sporophytes. These spores were observed to germinate freely, and the young gametophytes produced from them were apparently entirely normal.

As it might be argued that the small amount of gametophytic tissue left adhering to the isolated sporophyte might be necessary for the absorption of water, experiments were made in which the sporophyte was pulled out of the calyptra, leaving the foot behind. Although the larger part of these footless sporophytes failed to survive, nevertheless, a number of them lived for two months or more, and behaved very much like the others.

The only case in which there was present anything suggesting a formation of roots from the foot, was one where the bottom of the foot had been exposed by cutting away the underlying tissue of the gametophyte, thus bringing the foot into direct contact with the soil. A couple of short outgrowths, of the superficial cells, resembling rhizoids, were seen, but they were too inconspicuous to be of any great importance. It is hoped that further investigations may furnish more positive results.

This much can be definitely stated. The young sporophyte of *Anthoceros Pearsoni*, separated from its association with the gametophyte, is capable of a limited growth in length, and is able to mature normal spores and elaters from the young sporogenous tissue.

The following data may be of interest.

The greatest elongation noted, after transplanting, was about 3 mm. In most cases it was less than this.

The first planting was made on November 28. Some of these sporophytes were still alive on March 13. The foot had rotted off, but the chromatophores in the upper part were still green, and normal ripe spores had developed.

In the later plantings, many of the sporophytes were still alive when the experiments were concluded, ranging from six weeks to two months from the time of planting.

On January 13, a number of sporophytes, deprived of the foot, and thus completely severed from the gametophyte, were planted. Some of these were still alive on March 15. The cells of the broken end were still alive, but there was no evidence of rhizoid formation. Ripe spores and elaters were developed, as in the other experiments.